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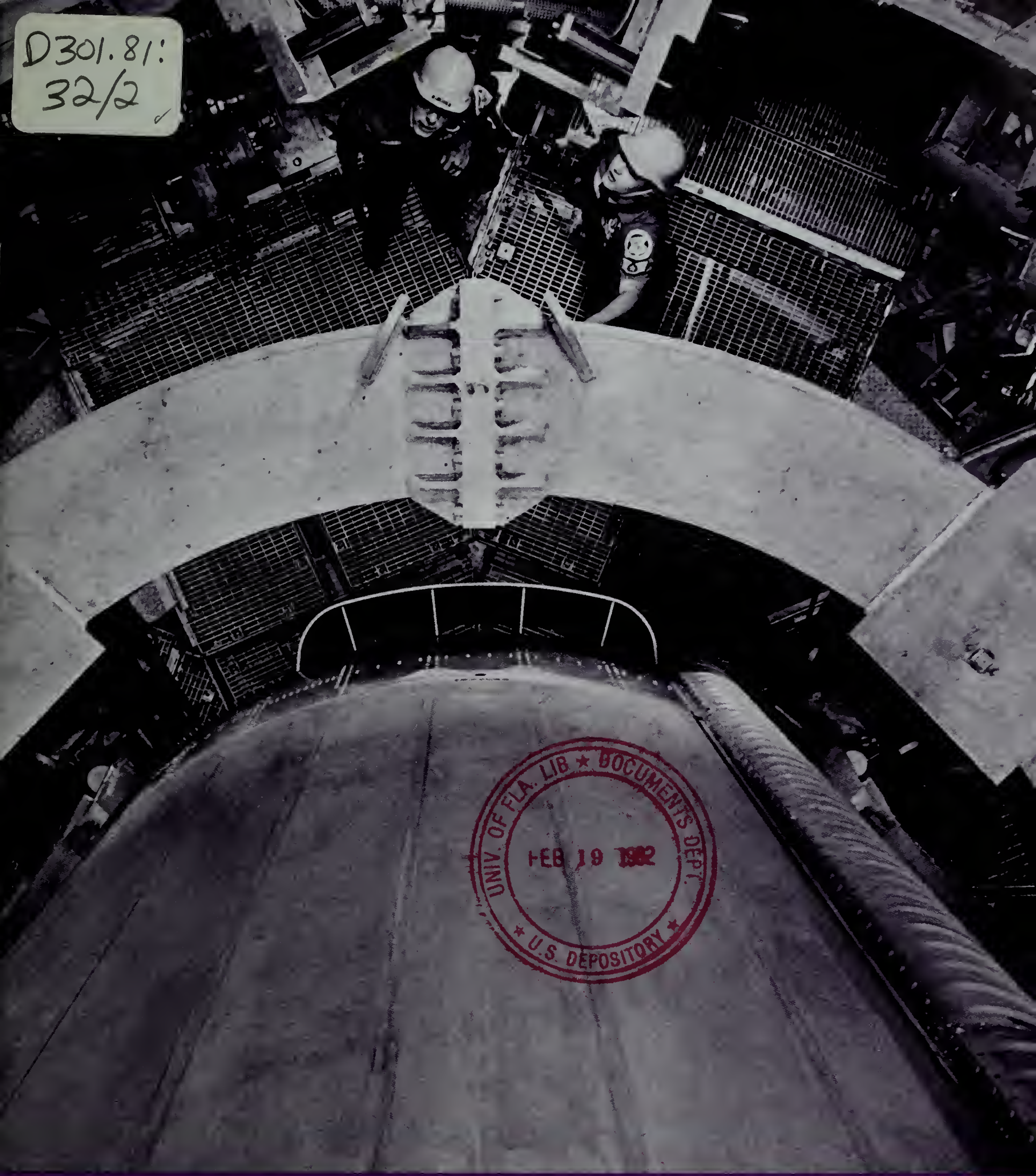

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# Combat Crew

strategic air command

★★★★

FEBRUARY 1982

# Combat Crew

*Magazine of the Strategic Air Command - 32nd Year of Publication*

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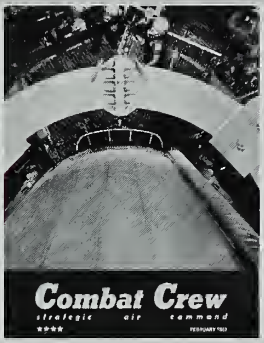

## ON THE COVER

**A Salute To All Titan II Crew Members**

**SACRP 127-1 VOL XXXII NO. 2 FEBRUARY 1982**

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DEPARTMENT OF THE AIR FORCE

**Lt Gen Robert T. Herres**
**Commander, Eighth Air Force**

Because SAC aircraft and aircrews are operating in a new environment, we need to ask ourselves some hard questions and be certain we are prepared for it. Do we, as aircraft commanders, rely too heavily on ARTCCs to maintain safe separation of our aircraft? Is the safe separation of aircraft a pilot responsibility or a total crew responsibility? Can we accomplish realistic EWO training safely? These are typical of questions which would seem vital to the maintenance of SAC EWO readiness and must be answered by each and every one of us.

With the advent of the FAA controllers job action in August, we, in SAC, have been thrust into an unfamiliar VFR environment, one in which flying SAC aircraft VFR is a reality. This reality must be dealt with by each of us in a professional manner. While the total IFR services for both military and civilian traffic is somewhat limited by the current FAA situation, we must continue to maintain our current EWO state of readiness even though some training may have to be conducted VFR. When flying VFR, maximum utilization of available military and FAA radar flight following service is essential.

Another question that comes to mind is "Do

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# SAC AIRCRAFT IN THE VFR ENVIRONMENT

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we fully understand VFR rules?" I'm sure the answer to this question is "yes," but are we, in fact, having difficulty recalling VFR rules after years of intense IFR flying? We must study and recall these VFR rules and be aware of the "pitfalls" of VFR flying. We need to be knowledgeable of the VFR rules concerning altitude separation, hemispheric altitudes, and overflight of high density areas. While flying VFR we must make every effort to realize the probability of inflight diversions due to IFR weather conditions, be extremely alert to avoid the dangers of getting caught in or between layers of clouds unexpectedly, and be aware of the problems associated with maintaining VFR cloud clearance criteria.

One of the questions often pondered since August is "is night VFR flying dangerous?" I feel that any abnormal situation while flying aircraft is potentially dangerous. However, our military flight training should have prepared us for these potentially hazardous situations. We must strive to get that "extra" pair of eyes out of the cockpit and make every use of a safety observer so that "see and avoid" can be a realistic concept. However, we will continue to monitor our instruments. Not only must they be relied upon for maintaining safe separation above the terrain while flying TA altitudes, they need to be used to assure the accomplishment of quality training. As SAC crew members, we must rely on each other as a team to help us monitor these instruments even if our bombing reliability may slightly suffer.

Now that we have mentioned some of the problems of VFR flying, let's talk about where we put these VFR rules into our daily missions. Where does the VFR mission start? We must be prepared to fly our daily training missions any of three ways — either total VFR, total IFR, or partial IFR and partial VFR. The most likely case will be IFR service to and from our low level training area and "VFR only" service throughout the low level portion of our mission. This is why we need more emphasis on our mission planning days. We need to prepare ourselves for all possible VFR contingencies that may occur and how we plan to handle them. Most of all, we should "table fly" our training missions to an even greater extent than we have before.

In conclusion, we, as operators of SAC aircraft, must adopt and maintain a "look, see, and avoid" concept of flying our profile training missions. At the same time, proper instrument procedures are imperative and need to be followed to insure that "safety is paramount." It is important that we continue to train in order to maintain our current state of EWO readiness and that readiness must never be degraded. For strategic deterrence to be credible, we must be well trained and prepared. Our primary goal of closed curtain EWO readiness can best be accomplished by training in an IFR environment; however, our expertise in simulating these conditions in a VFR environment might be our "ace in the hole." ★★★

# TWENTY YEARS OF TITAN II

Major Carl A. Wolfrum, Jr.
390 SMW
Chief of Safety

While SAC was developing the Minuteman system and installing it at northern tier bases (see "Malmstrom's Twentieth", *Combat Crew,* July 1981), work was also going on with the installation of the first operational Titan II unit at Davis-Monthan Air Force Base, Az. On January 1, 1962, elements of what was to become the 390th Strategic Missile Wing were activated, including the 570th Strategic Missile Squadron, the 390th Missile Maintenance Squadron, and the 390th Headquarters Squadron. The 390th had a proud history as a member of Eighth Air Force during World War II. Their mission at that time was to participate in the bombing offensive against German-held territory on the continent of Europe. Early missions in 1943 were directed against the strategic industries at Regensburg and Schweinfurt, but, as D-Day approached, the emphasis of combat missions shifted to disrupting the enemy's transportation facilities. The last combat mission flown was against the railway transportation centers at Oranienburg on 20 April 1945; however, the 390th stayed in Europe after the war air-dropping supplies to Dutch civilians and returning liberated prisoners-of-war to their homelands.

Although the wing had been reactivated in 1962, work had begun on the Titan II missile facilities over a year earlier. The site construction program had been divided into three phases.

Phase I had begun with ground-breaking ceremonies on 7 December 1960. Included in this initial work was the construction of access roads, excavation of pits and shafts, placing of reinforced steel, and the pouring of concrete foundations and walls. During this phase, contractors dug up 2,000,000 cubic yards of material, poured over 200,000 cubic yards of concrete, and used almost 50 million pounds of steel in accomplishing their work. Phase I took over a year to complete, but before it was done, Phase II had already started. This portion of the work included completion of heavy construction and the installation of support equipment, such as air conditioners, the diesel generator, and the fixed propellant transfer system. Miles of electrical wiring and plumbing were added to the complex. This phase of the work was completed in December of 1962.

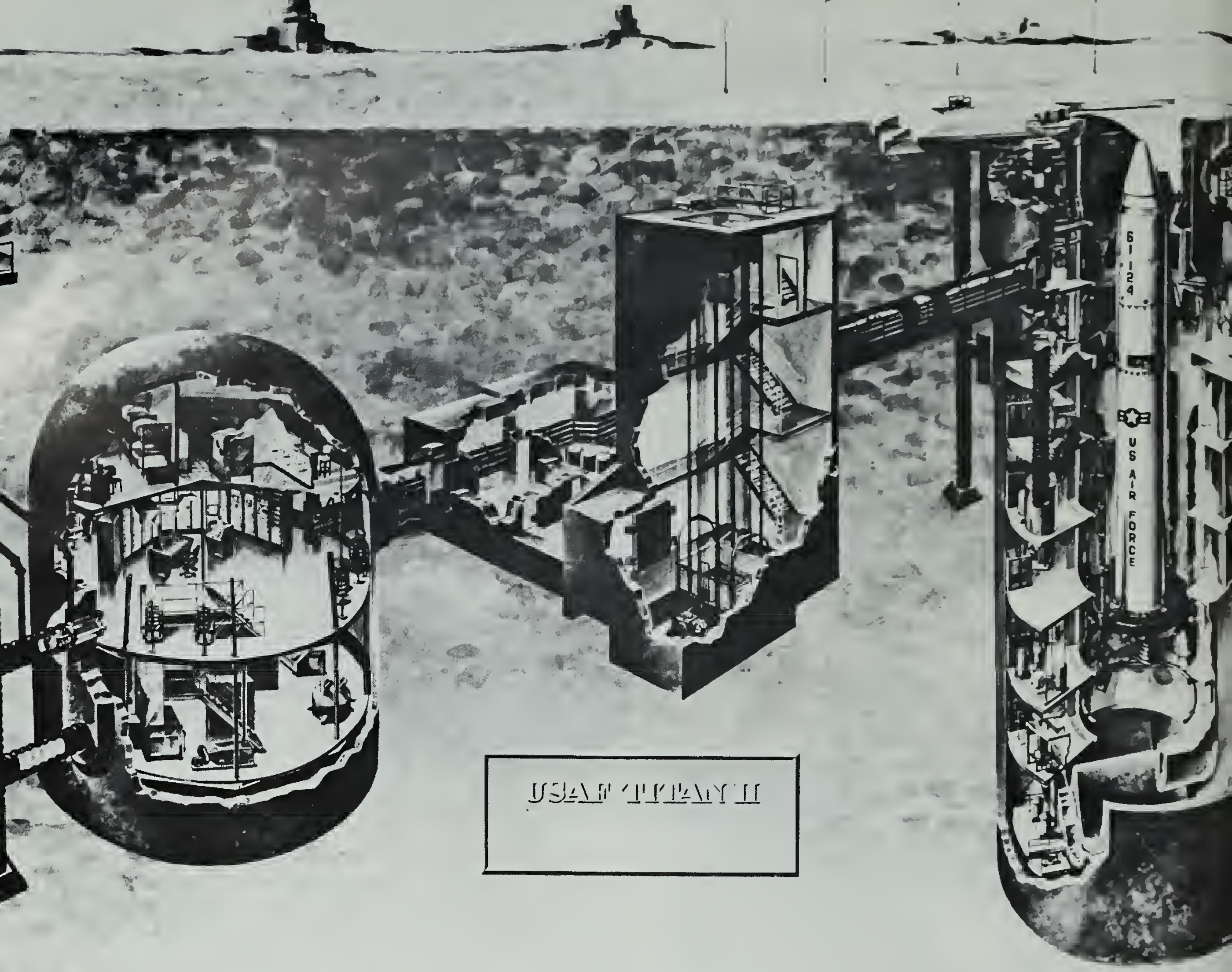
**bleway between blast lock area and missile silo.**

**Looking down on level seven from level six. Ring in foreground is missile thrust mount.**

Phase III began at Complex 570-2 in May of 1962. It consisted of installing and verifying the missile and its associated equipment. The highlight of this aspect of the work was the arrival, on 27 November 1962, of the first Titan II missile from Lowry AFB. It was installed at Complex 570-2 eleven days later. On 1 December 1963, the last of the complexes were turned over to SAC and the 571st Strategic Missile Squadron gained full operational status.

While the silos were being constructed, the initial cadre of crews and maintenance personnel were being selected and trained. This was also a three step process. Initial training was provided at Sheppard AFB, Texas with additional operational readiness training at Vandenberg AFB, California and in the local unit. This basic training pattern has continued to the present day.

The Titan II has not been a static system. Almost from the beginning, it has undergone a variety of major and minor modifications, each of which was designed to increase the reliability, survivability, or maintainability of the system. Advances in the state of the art have been incorporated through such modifications as "Yard Fence" or "Extended Life". In addition, an active follow-on test launch program in the late 1960's assessed the reliability of the weapon system. The wing participated in nine of these launches between March 1965 and November 1968.



The cornerstone of the wing's activities has been, and will continue to be, the Daily Shift Verification (DSV) performed by the combat crews. This checklist, over 200 steps long, takes the Titan II crew into almost every corner of the site to check equipment operation and document discrepancies. Discrepancies are turned in to the maintenance activity for prioritization and scheduling. The DSV checklist is the proverbial "stitch in time that saves nine".

The DSV checklist indicates one of the main differences between Titan II and Minuteman — the crews' physical proximity to the weapon system. The Titan II crew often finds itself conducting the initial stages of malfunction analysis, investigating a potential hazard, or clearing a security situation. They are heavily involved in anything that happens at their site.

The other big difference between the weapon systems lies in the physical qualities of the propellants. Both of the Titan II propellants — nitrogen tetroxide and a hydrazine mixture called Aerozene 50 — deserve the utmost respect. They are both highly toxic. The onload or offload of propellants gets the attention of the entire wing, from the commander on down. Maintenance personnel in direct contact with the system wear special closed environment rocket fuel handler's suits and the operation is closely monitored by site and base teams through completion.

The 390th has continued the tradition of its predecessor with three outstanding unit awards and numerous trophies at the annual missile competition, including the Blanchard Trophy in 1979. Perhaps its most significant achievement, however, is something for which it has never received a ribbon or a trophy — over eight years without a major mishap.

The Titan II weapon system presents special challenges to those who are associated with it. As it enters its 21st year of operation, the 390th will continue to meet those challenges with pride and professionalism.

# LOW LEVEL DOWN UNDER

**1st Lt. Donald A. Welch**
**60th Bombardment Squadron**

ANDERSEN AFB, Guam — Assignment to the 60th BMS offers many unique opportunities for the B-52D navigator.

High and low level simulated bombing in Korea, Busy Observer (sea surveillance) missions all over the Pacific, and actual overwater navigation are just a few. Probably the most challenging, however, are the Busy Boomerang low-level training missions to Australia.

Like most Strategic Air Command training missions, Busy Boomerang has its beginning on mission planning day. In the morning briefing, crews are briefed on the route and specific control times that must be met. They are told of special procedures to use for communicating with the various air traffic control agencies and actions they must perform when a clearance is delayed or cannot be obtained. During the briefing, the crews receive completed mission paperwork. The rest of the day is spent discussing the mission in detail, coordinating cells and receiving target study.

The next morning starts with a 4 a.m. assembly time at the squadron. After updating the crew information file, the crews stop off at the in-flight kitchen, helmet shop and base operations. Base weather personnel alert the crews of tropical storms in the area of the low-level routes in Australia. If the weather is too severe, the crews will fly a back-up mission in the local area.

After a minimum interval take-off or cell take-off, the aircraft turn south to exit the Air Defense Identification Zone (ADIZ) and enter a timing box prior to a rendezvous with two tankers 70 minutes into the mission. At the air refueling initial point, the bombers are cleared to descend below the tankers and initiate closure to begin air refueling. Each bomber receives 70,000 pounds of fuel on the 44-minute track.

Just south of the refueling point is a small atoll, which is the last available update for the bombing navigation system until south of the equator, one hour and fifteen minutes later. Good dead reckoning is important, since celestial procedures may not be accomplished until after air refueling. The light and variable winds generally found around the equator make dead-reckoning positions easy to keep accurate.

The first simulated bomb run comes approximately 50 minutes after air refueling and three hours and five minutes into the mission. The bomb run is a contingency high run on an inactive volcano, on Manam Island, just off the northern coast of New Guinea. The lead bomber uses synchronous procedures while number two simulates radar malfunctions and uses an alternate procedure. After the bomb run, the flight continues south across Papua, New Guinea, to a cell break-up point, from which each bomber continues on its separate routing to the primary entry control point, approximately four hours and fifteen minutes after take-off.

The two Busy Boomerang low-level routes in Australia are IR-984 and IR-985. They are located in northeast Australia on the Cape York Peninsula. Each route begins with a short leg over land during which the descent is accomplished and is followed by an approximate 70- to 75-mile leg over water at the end of which a terrain avoidance equipment calibration is completed. Following the TA calibration, both routes continue over land.

**Continued on Page 20**

# An Afternoon in the Life

1st Lt Timothy Moore
CoPilot B-52D

The following is an account of an actual low level bomb run. Only the names have been changed to protect the innocent.

SETTING:

Early afternoon; low level at Missmark Bomb Plot (IR999), aboard a B-52D.

(Scene opens with the crew on bomb run heading, IP inbound, toward the targets.)

(Fade in)

RN: Crew! Standby for TIP (timing initiation point); Ready . . . ready . . . now

(Pause)

RN: Pilot, I'm in bomb. Initial offset acquired. Say PDI.

P: One left.

RN: Center the PDI. Nav . . . checklist!

(Pause)

P: Hey, Radar! The PDI jumped 20 right!

RN: @(#*&$¢%¢&#! I've just lost the radar scope, Pilot. Co, Nav, it's your run . . . Co, did you get a good watch? Nav, how's the true heading?

CP: Affirmative, visual timing off of Horsefoot lake road.

(The road is the pilot timing initiation, point, PTIP)

NAV: Nav's watch is good. Heading crosschecks.

RN: OK, Co; it's yours. Pilot, I'm going to check circuit breakers.

(Pause)

CP: (To himself)
That looks like the road out of Muttle . . . at least I think that's it . . . yeah, that's got to be it. I'll start my watch there.

(The road out of Muttle is the next visual update timing point after the PTIP)

(Over interphone)
Nav, coming up on my first update; rehack your watch, ready . . . ready . . . now!

NAV: Timing.

(The targets are all visuals. The first target is a farm building. There are many farming complexes in the area. This farm has a feed yard and three silos to the north.)

(Pause)

(We pick up the action again past the co-pilot's timing for release.)

CP: (To himself)
Hmmmmm, I've got a farm ahead that looks like the target, but the timing . . . hmmmmmmmm. That's got to be it.
(Over interphone)
Crew, I have the farm. Pilot! Line up over the barn to the right.
(The co-pilot gives the pilot directions by pointing out the window toward the complex.)

P: Roger.

NAV: (To himself)
Timing doesn't look right.
(Out loud)
Timing doesn't crosscheck, Co. You have it visual?

CP: That checks.

NAV: Take it!

CP: Check tone on . . . doors . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . .
HACK!
(Over the radio)
Bombs away! Bombs away!
(Over the interphone)
Pilot! . . . heading 275!

RN: I think we found the problem, it was one of the fuses used for the power supply. How does the PDI look now?

P: 2 right.

RN: Center the PDI.

P: Roger.

RN: Nav, checklist.

(The rest of the bomb run is uneventful)

(Fade out)

Good save, right? . . . . . . . . . . WRONG.

The crew released long on an innocent farm a couple miles down track from the actual target.

What went wrong? Nothing good integrated bombing techniques (IBT) wouldn't have prevented. The crew was not ready for an integrated bomb run. The pilot team is the key here. They must know the run visually from the turn onto the bomb run to the last release. The visual targets being the most important. Timing between visual updating points and the release point is also critical as well as cross checks with the time to go meter (TG) on the pilots data indicator (PDI).

Did the co-pilot really start his watch at the pilot timing initiation point, PTIP, in this case? . . . No. The PTIP was a road crossing the flight path about one mile west of Horsefoot lake. By the time the crew found out about the radar problem they were past Horsefoot lake. The co-pilot chose another road just west of a small dry lake bed, similar to Horsefoot lake. Know your run visually!

The visual updating points were there of course but the co-pilot was not confident of the timing to and from these points (The times did not look right). An early comparison of his watch with the TG drive would have indicated problems and he would have realized he used the wrong PTIP. With a good PTIP and thorough understanding of the timing between this point and the next visual, he would have chosen the north-south road out of Muttle instead of using the ". . got to be it." road.

". . 5 . . . 4 . . . 3. . . 2 . . . 1 . . . HACK!" Right on target? No. The target was a farm complex alright, but with close scrutiny the co-pilot would not have released on the farm complex that had a road to the east, but instead he would have released on the actual target a couple miles prior. Remember the farm with the feed yards and the silos? Know your targets.

There are three important lessons to be learned by the pilot team here. The pilot team must know the bomb run visuals, have a good working knowledge of times and TG comparison, and, most important, be able to identify the targets visually to effect an accurate release.

There are several other techniques that the crew has developed to effect precision releases. In the B-52D, the use of the heading set marker, and Time To Release tables (TTR) are two additional valuable bombing techniques.

Even if the correct complex was found, would the co-pilot and the pilot be talking about the same farm. Nothing can be more confusing than flying by the direction of a pointed finger. To make his directions clear, the co-pilot now uses the manual steering bar along with the heading set marker to place the aircraft over the correct target without interphone chatter. This along with a reliable BNS BRL will make the release good.

In our scenario, no information is available from the downstairs team, other than basic navigation, therefore the pilot team must also direct a weapons release (Cut the tone at the BRL; Bomb Release Line). There are many rules of thumb used by pilots to visually cut the tone. Some wait two seconds after the visual cue passes under the nose. Others cut the tone as it passes under the nose. The actual time to release is more complex than that. It depends on three factors; actual aircraft altitude, ballistics altitude*, and the ground speed. The following is a table of time to release based on ballistics altitude and ground speed, used for EWO profiles.

Continued on Page 24

**FIGURE 1**

**TABLE FOR TTR (sec)**

| GS | 300 | 310 | 320 | 330 | 340 | 350 | 360 | 370 | 380 | 390 | 400 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BA feet | | | | | | | | | | | |
| 400-499 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 500-599 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| 600-699 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 700-799 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| 800-899 | 3.0 | 3.0 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.0 | 2.0 |
| 900-999 | 3.5 | 3.5 | 3.5 | 3.5 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| 1000-1499 | 4.5 | 4.0 | 4.0 | 4.0 | 4.0 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |

**BA = BALLISTICS ALTITUDE** **GS = GROUNDSPEED**

# Mission Planning? . . . Haven't Got the Time

**Captain Richard K. Jones**
**924 Air Refueling Squadron**
**Castle AFB**

"Tanker 52, this is Oakland Center. I show you 27 miles off course for your next filed point of the Coaldale 058/26."

"Center, this is Tanker 52, uh, standby."

"Pilot, this is Nav, we got a recip here. That point is supposed to be the Coaldale 238/26."

"Roger, Nav. Center, this is Tanker 52. We're awfully sorry, sir, but we're requesting that point be changed to the Coaldale 238/26."

"Roger, 52. You're cleared as requested . . . I'll let you go this time." Whew. The crew breathes a sigh of relief. Oh well, just one of those things. Probably never happen again, they think to themselves.

Does the above scenario sound familiar? Hopefully it doesn't, but I bet it does. What caused this situation? Probably, it was caused by inadequate mission planning. Thorough mission planning is essential to a safe flight. Therefore, it is essential that crew members have adequate time to thoroughly plan a mission on mission planning day. Right? I think most crew members would agree. Unfortunately, though, there are numerous demands on our time.

Ground training requirements and additional duties sometimes place such heavy demands on crew members' time that they no longer have adequate time to mission plan **as a crew.** The following hypothetical example may help to illustrate this. On mission planning day, the aircraft commander was scheduled for his annual physical in the morning and the navigator had to work on his additional duties part of the morning. Also, the copilot was scheduled to fly ACE and the boom operator was scheduled for Chemical Warfare Defense training in the afternoon. During the morning, each crew member, at various times, did accomplish his/her part of the mission planning. The crew assembled for a quick crew briefing at 1130, the first and last time the crew was together the whole day. At 1145 the briefing was over, the paperwork was filed, and mission planning was completed. Sounds okay so far, doesn't it. Or does it? Was the mission thoroughly planned? Let's take a look.

No, the mission planning was inadequate for a variety of reasons. There was not enough time for the aircraft commander to double-check the copilot's takeoff data and fuel log. There was not enough time for the copilot to check each point on the copilot's map for accuracy. There was not enough time for the navigator to accomplish his precomps. There was not enough time for the crew to discuss what they would do if they had an engine failure immediately after takeoff. There was not enough time for the crew to discuss what they would do if the air refueling was cancelled. Does **this** scenario sound familiar? Again, hopefully it doesn't, but I bet it does. What can be done to prevent this from happening to **you** and your crew?

For a start, look upon mission planning as your foremost duty on mission planning day. Plan your personal activities (including additional duties) to insure you have enough time to thoroughly plan the mission. Next, if you are scheduled for a ground training requirement that could conflict with your mission planning, try to get it rescheduled. SACR 50-12 states that "Unit Staff will insure that flight crews are provided a minimum of eight hours (four hours for KC-135) to accomplish crew mission planning and mission briefing . . . Mission planning must be accomplished as an integral crew to the maximum extent." Therefore, each crewmember should have the **same** time period to mission plan. Also, eight hours (four hours for KC-135) may not be adequate time to thoroughly plan the mission, depending on the type of mission to be flown. If you don't have enough time, then get more time. Finally, realize that with thorough mission planning, you will probably have a safe and enjoyable flight. With inadequate mission planning, it might be your last flight. Mission planning? . . . Haven't got the time? Make the time.

# OPS HAZARDS

YOU'VE HAD IT!

## DANGEROUS $H_2O$

During a planned dry takeoff for an HHQ mission, the S-1 acceleration check was good; however, the aircraft did not unstick at the planned air speed. The aircraft was finally pulled off the runway with full aft stick after approximately 13,400 feet of ground roll. The mission was continued and after arrival in the traffic pattern, the crew noted two units more nose up trim were required than normal. After landing the long ground roll was blamed on the upgrade pilot and the possible trim problem was written up on the 781.

The next morning, the possibility of water being loaded was brought up. The IP and a crew chief put power on the aircraft and pressurized the water system. Water flooded from the engine. Investigation revealed water had been loaded prior to the flight and the 781H indicated it had been downloaded. Investigation further revealed that the motor which drives the water drain valve was burned out and the valve did not open. Maintenance personnel, during preparation of the aircraft, had moved the drain switch to open and observed no water coming from the drain. It was assumed water had been drained earlier.

This and a similar incident at another base created a high potential for the loss of an aircraft and crew. The crews, however, did not have to rely on maintenance to insure water had been drained. There is a water site gauge in the wheel well. Do you know where it is!

## WHO'S TRIMMING?

The second sortie was scheduled to remain in the local traffic pattern and was delayed due to alternator problems experienced during the first flight. Preflight was accomplished and takeoff trim was checked and set with the last direction of rotation being nose up. The copilot made the takeoff and the pilot performed copilot duties. After takeoff everything appeared normal, and the pilot began obtaining ATC instructions and visually clearing the aircraft.

The copilot suddenly called for help. When the pilot looked back into the cockpit, he saw the copilot holding full forward yoke, the aircraft in a 20-degree nose high attitude and the airspeed at 110 knots, decreasing. The pilot grabbed his own yoke, thinking the copilot was not trimming properly, and tried to trim nose down, also with no effect. Airspeed at this time decreased to 105 knots and a light buffet was felt in the left wing.

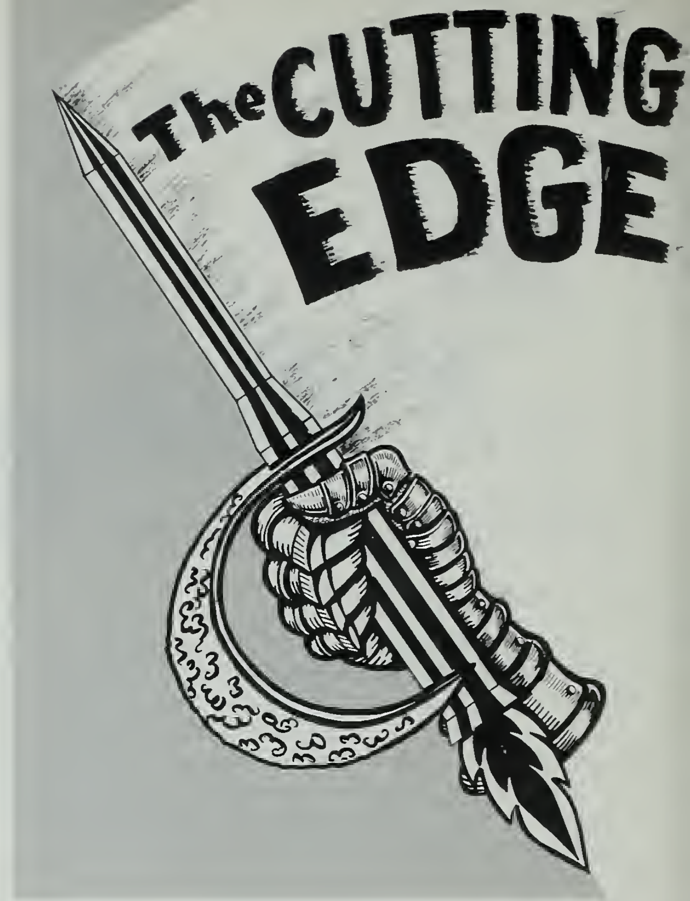
As he was considering bailout, the pilot realized the engines were at full power and saw the stab trim moving slowly on its own to the nose up position. He reduced power to decrease the pitchup tendency, cut out the electrical trim and manually retrimmed the aircraft. The high pitch attitude was reduced and control of the aircraft regained.

After landing, investigation revealed one phase of the three phase trim motor had shorted out. This caused the subsequent burn out of two relays through which the pilots' electrical trim switches and the force cut-out switch operate. During takeoff the trim moved slowly in the nose up direction with no normal electrical control available to the pilots. The stab trim cut-out switch was activated just in time to prevent a catastrophic mishap.

## ASSUMED POSITIONS

The tanker was lead in a two-ship HHQ F-4 ferry mission. After leveloff, the crew attempted to burn fuel from the body tanks for a system check. They found they were unable to burn fuel from either the forward body or aft body tanks resulting in 27,000 pounds of trapped fuel. Fuel available was insufficient to continue the deployment and they returned to home station. Post flight inspection found the aft body level control valve switch in the open position. It was also revealed that the indicator light in the single point refueling panel did not illuminate with the aft body switch in the open position, and the panel cover could be closed with insufficient resistance.

Incidents of this kind are not new. The only sure way to prevent recurrence is to take the time to visually insure each switch is in the closed position.



# CPOs in Perspective

**Captain Kirby Mifetze**
**4315 CCTS/3901 SMES CPO Working Group**

What's new in ICBM training and evaluation? Over the past year probably the most significant addition has been the implementation of Comprehensive Performance Objectives (CPOs). In October of 1980 a conference at Vandenberg AFB was held to explain how and why CPOs were developed and how they would be implemented. Though CPOs have been modified and updated, their purpose has remained the same: to guide the training and evaluation programs for SAC missile crew members. But during the year, through unit visits, conversations with unit personnel, and correspondence addressing CPO use, several items have repeatedly surfaced. First, are CPOs used to govern training in the MPT in the same way they govern evaluations? Second, are CPOs practical? And third, should crew member training be tailored to meet only the minimum standards found in CPOs? Let's examine each of these issues with regard to the perceived use of CPOs versus the intended use of CPOs.

First, CPOs are used in training and evaluation. One of the basic principles of CPOs is that they would be used in MPT presentations and controllable problem presentations in the field. But there is a distinction between how CPOs may be used in training and evaluation. SACR 50-16, Vol II, paragraph 3-7b states, "Training scripts may exceed basic CPO condition/standard constraints if the intent is to provide enrichment training, increase student understanding, or enhance proficiency." (It is important to note evaluation scripts must not exceed CPO conditions/standards.) This clause allows presentation of challenging scenarios to the highly proficient crew member. It does not allow heavy-handed use of complex scenarios. In fact, the regulation prohibits criticism of student members unable to achieve conditions or standards that exceed CPO limits. At some units this training option is not being used even though it could be of considerable value. Experience would be gained for both students and the instructors who develop, approve, review, and present the training. In a sense CPOs are to **guide** training scenarios and **restrict** evaluation scenarios. CPOs establish minimum acceptable command standards for operational proficiency. That is what evaluations are concerned with. Creating the most qualified crew force possible is the desire of training.

The second issue ties in to the first — the lingering doubt by some regarding the practicality of CPOs. If you train to higher standards than found in CPOs, why have CPOs? Remember, there are restrictions on how the results of these modified events are used — thanks to CPOs. The primary point of contention is what we call the "what if" scenario. The basic irrefutable argument, "It could happen," is generally used to support "what if" scenarios. Such scenarios generally do not fall within CPO limits and are not presentable in evaluations. But what about training? Here is the tie-in to the previous paragraph. If the scenario meets one of the intents previously mentioned, allow its use. But this is where being honest with yourself and being responsible enters in. When developing CPOs, we decided the "what ifs" should be handled by thoroughly training the smaller situations which normally make up the larger, more complex scenario. We assumed the crew member had been trained, certified, and possibly evaluated in the tasks which would comprise the complex scenario and expected the individual to reason logically to apply his/her training. By breaking down the complex scenarios into smaller tasks, the crew member would be able to correctly handle the situation. We, the CPO writers, are the first to admit that CPOs do not address everything that could possibly happen during an alert tour. But we do believe that if a crew member is able to deal with conditions and standards as given in CPOs the vast majority of problems which occur in the field can be handled. In a practical sense, it would have been unrealistic to attempt to list each and every imaginable possibility in CPOs. Also in a practical sense, training "what if" scenarios may not be proper use of MPT time since such scenarios are usually very problem specific with little broad base for practical application. It comes down to this: CPOs have been established as the minimum command standard for training and the maximum command standard for evaluation of operational performance. Use CPOs to support the training and evaluation programs.

Finally, the third issue. Training seems to be tailored to meet only the minimum standards found in CPOs. On first reading this appears to be exactly what we are asking for in the previous two paragraphs. Not so. So far we have been addressing training procedures through use of equipment, either in the MPT or in the field. What we're concerned about now is that all technical and background training seems to be driven by CPOs. If this perception is correct, changes **must** be made. The key word in Comprehensive Performance Objectives is **performance.** CPOs were designed for application to procedural skills, not knowledge. But it isn't necessary to limit knowledge to only that necessary for performing in accordance with CPOs. As mentioned earlier, the crew member should be able to reason out how to deal with a problem in the field. To do so requires practical application of technical knowledge. A crew member's future provides another reason for developing a strong background knowledge in the operation of the weapon system. A crew member is a crew member for the short run, yet many will be career missileers. A sound background in the weapon system will serve a career missileer long after procedural skills have diminished or disappeared. In the long run, background knowledge may be more important than procedural skills. An overall increase in technical knowledge should increase procedural skills as the knowledge is practically applied. Try it. Give the crew force the opportunity to learn more than the minimum and you'll find many takers. Don't use CPOs to dictate classroom instruction. CPOs are performance oriented and are not intended to limit classroom training.

These are our views on three of the more common CPO-related issues. CPOs are not the final answer to all problems in training and evaluation. They are tools for training and evaluation. We are convinced proper application of CPOs will benefit the entire missile force. As General B. L. Davis, CINCSAC, noted recently in an article in this publication, "Technical knowledge, procedural skills, and an understanding of people around you are critical elements of individual proficiency." Remember, our goal is a proficient crew force.

# TLAR
# VS
# The 60:1 Rule

**Capt Mark Stornont**
**ACFT Commander**
**904 AREFS**

"That Looks About Right" (TLAR) is a tried and often used aviation technique. Due to a lack of previous flying experience, Orville and Wilbur probably used a lot of it during their first flights. Even now experienced pilots continue to use this technique. Call it air sense, a sixth sense, seat of the pants, whatever; TLAR works for some people sometimes, but there are no guarantees. TLAR is difficult to teach; works best on calm, clear days at the home base; and for you ACE jockeys, TLAR in a T-38 or T-37 is different than TLAR in a B-52 or KC-135. During instrument conditions, TLAR can rapidly become a fatal technique.

Precise instrument techniques that work in all aircraft in all situations evolve from the 60:1 rule. Developed and strongly advocated at the now defunct Air Force Instrument Pilot Instructor School (IPIS), 60:1 instrument techniques were taught at IPIS to instructor pilots from all commands. Revised in 1976, AFM 51-37 now contains numerous 60:1 techniques. These are well proven, universal techniques. However, a common heard complaint about 60:1 is that it takes too many mathematical computations while trying to fly an aircraft. My objective in this article is to dispel that myth and provide a few basic techniques enabling you to fly a precise, controlled aircraft from the enroute altitude structure to published minimums.

The 60:1 rule is based on the fact that 1° at 60 NM equals 6,000 ft (approx 1 NM). This means that when you alter the pitch of any aircraft (Cessna 150 or SR-71) one degree you will descend or climb at the rate of approximately 100 ft per NM. See Figure 1. Thus:

$$1^\circ = \frac{6{,}000'}{60\text{ NM}} = \frac{100'}{\text{NM}},$$

$$3^\circ = \frac{18{,}000'}{60\text{ NM}} = \frac{300'}{\text{NM}}, \quad \text{etc.}$$

$$2^\circ = \frac{12{,}000'}{60\text{ NM}} = \frac{200'}{\text{NM}}, \quad \text{and}$$

Therefore, by dividing the altitude to lose by the distance to travel, the descent gradient (no wind pitch change) and required altitude loss/NM for **any** descent can be precisely determined. Now stay with me through some simple mathematics. To descend from FL 350 to 5,000′ in 50 NM (no wind) requires a 6° pitch change from level flight and a required altitude loss/NM of 600′/NM;

$$\left( \frac{35{,}000' - 5{,}000'}{50\text{ NM}} = 6^\circ \text{ pitch} = 600'/\text{NM} \right).$$

If all those zeros confuse you like they do me, drop them and think in terms of

$$\frac{35' - 5'}{5\text{ NM}} = 6^\circ \text{ pitch} = 600'/\text{NM}$$

To maintain this, the altimeter must decrease 600′ each 1 NM.

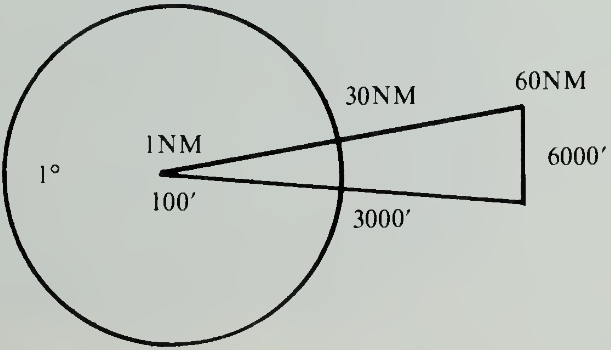
The next step is to multiply MACH times pitch and attach two zeros to determine VVI. For example, flying at .6M and 6° pitch equates to .6M X 6° = 3.6 = 3,600′/min or .7M X 5° = 3500′/min or .3M X 3° = .9 = 900′/min. Your 60:1 instrument crosscheck is now established: ADI equals required pitch; altimeter and DME confirms required altitude loss/NM; and VVI equates to MACH X pitch. In a strong wind condition, the descent gradient and altitude loss/NM always remains the same but it may take a different than planned pitch (less for headwind and more for tailwind) to achieve it. See Figure 2. As pitch changes, the VVI (MACH X pitch) will also change. But the **key** is to do what is necessary to maintain the proper altitude loss/NM throughout the descent. The following mental steps will help you achieve that:

1. Determine pitch and feet to lose/NM: alt ÷ dist
2. Determine VVI: MACH X pitch + two zeros
3. Crosscheck altitude loss vs distance traveled: altimeter vs DME
4. If necessary, adjust pitch for winds to maintain required altitude loss/NM
5. Recompute VVI as MACH and/or pitch changes
6. Start over again at Step 1 and update as the descent progresses.

The next 60:1 technique determines lead points for arcs to radials and 90° course intercepts. Since you travel 1° per NM on the 60 NM arc (See Figure 2), the number of degrees per NM at any arc/DME can be determined by

$$\frac{60}{\text{arc/DME}},$$

i.e. at 30 NM, $\frac{60}{30} = 2^\circ$ per NM. To convert this into a 30° bank lead point, multiply it by your NM turn radius ($M^2$, M-2, mi per min - 2, etc). For example, an aircraft on the 15 DME arc traveling at .4M requires a lead point of 8° ($\frac{60}{15}$ X (4-2) = 8°). I believe two other common intercept relationships are important; 60° intercepts and intercepts requiring a 180° turn. At an intercept angle of 60°, multiply the computed 90° lead point by ½. In the above example, our lead point at 15 DME and .4M would be 4° (½ of 8°). When determining teardrop offsets in low altitude approaches or offsets in a holding pattern (180° turn required to intercept the inbound course), multiply the computed 90° lead point by 2. For example, if you are holding at 30 DME and .5 M, you should offset approximately 12° from the inbound course ($\frac{60}{30}$ X (.5-2) = 5° X 2 = 10°). These lead point/offset techniques will enable you to position the aircraft on or extremely close to the selected course. Increase or decrease these lead points to compensate for known winds.



**ONE DEGREE = 100 feet per mile**

The example takes one degree segment extracted from a 60 NM radius.

At 60 NM one degree equals 6000 feet or 1NM. (rounded off)

At 30 NM one degree equals 3000 feet or ½ NM (rounded off)

At 1NM one degree equals **100 feet**

Fig. 1

**Continued on Page 21**

# IS IT REALLY MAGIC?

By Capt Carl H. Berdahl,
916 AREFs, Travis AFB

How would you like to have a complete and accurate set of KC-135A takeoff data in six seconds? It's being done. When you show up at the squadron before a flight to get your gear and the man in the "white scarf" appears, wouldn't it be nice to have a quick and accurate check of your takeoff data? If you work in Current Ops or at a tanker task force would knowing the maximum takeoff gross weight for given conditions in just a few seconds be helpful? I'm willing to be that you'll say YES! And, if you're curious about how all this is possible, read on.

Recent advances in computer technology have made possible the low cost, hobby size, computer. But don't let the low cost fool you; these machines have amazing computing power that must be seen to be appreciated. I'm going to describe how this power has been applied to computing takeoff data and speculate on the impact of this capability.

When you sit down at a machine such as the Celestial Training Device (North Star Horizon computer) and type in your takeoff conditions, it certainly isn't immediately obvious how the results can appear. But there's no magic. The machine is simply "crunching" formulas. The formulas come from one of two sources: the basic aeronautical equations or curvefitting (turning a curve into an equation).

The basic aeronautical equations are generally the most accurate and convenient. However, if you're building a performance manual, you soon find that you can't always use the nice, clear-cut aeronautical equations. Sometimes the engineer has to make a judgment about the data available to him, both calculated and flight test. He generally uses the more conservative data in order to give flight crews safe information to use. The RCR correction to refusal speed and critical engine failure speed is a good example of this. There is some subjectivity involved in building this correction grid. Consequently, it becomes convenient to resort to curvefitting since curvefitting just mathematically copies the performance manual curves. Here, you read several values off a given set of curves and generate an equation which copies the curves. This can be done using a computer. The generated equation can be checked by entering the original values and comparing the equations results with what you get from the curves. A computer can run this comparison in a few seconds.

I and a few other people have used one or both of these techniques to create takeoff data computer programs for the KC-135A. I'll describe my program since I know it best. The description will show what the computer can do and should stimulate discussion among us crew dogs about the comparative strengths and weaknesses of the different programs. It certainly can save us a lot of headaches, but I'll let you, my fellow pilots, be the judge of that.

When using my program, you enter the givens such as temperature and pressure altitude when directed by the computer. It will accept temperatures of -60 to 120°F, pressure altitudes of -1,000 to 16,000 feet, (dry thrust) gross weights of 120,000 to 297,000 lbs, flaps 20° or 30°, RCR 4 to 23, runway available of 4,000 to 16,000 feet, obstacles within the performance manual chart limits for stabilizer trim setting, wet or dry thrust, TRT or reduced thrust. The program accepts max mode climb profile only at this time and does not correct for wind or RSC. These restrictions could be lifted if the interest justified the work.

The program automatically calculates the reduced EPR's if required, and chooses the appropriate EPR. It also checks what you enter to keep you out of trouble. For example, it won't calculate a set of reduced thrust data with a wet runway. Obviously this checking capability of a computer and the fact that it has a much higher degree of reliability than a human increases the safety of a takeoff considerably from a takeoff data standpoint.

But how can all this computing power be used in accomplishing our mission? Aside from the obvious use in daily flying, the program can be used with modest modifications, in some cases, as a learning aid, generating tabulated takeoff data (tab data) for a given base, generating tables of maximum takeoff gross weights at a given airfield for varying conditions, and making fuel dump tables for emergency air refueling crews. In an "operational" environment (e.g. tanker task force), the program can provide fast answers to urgent performance questions.

For normal training missions, a convenient modus operandus is to handwork a set of takeoff data on mission planning day for your target conditions, and then check your work with the computer. You can also make a miniature set of tab data for conditions varying slightly about your target conditions. This can save you time and gas if conditions change at the last minute. Additionally, you've handworked a set for training purposes and checked it to insure its accuracy. The overall safety and convenience of your takeoff are improved as a result.

Now some very important questions arise from all this discussion of using computers for takeoff data. Here are three major ones. Won't crews forget how to do takeoff data if they use the computer all the time? How do I know it's accurate? How do we integrate this new capability effectively into our daily operations?

I'll take the second question (about accuracy) first. I described earlier a technique for verifying accuracy during my discussion of curvefitting. After the curve has been fitted, the computer can use the equation it has generated to check how good a job it has done. I've done this through all my curvefitting and can state the maximum error that occurs on any of the curves I have fitted.

Another verification technique is to run a given algorithm, (problem solving method) say the rotate speed algorithm, from one person's program against the corresponding algorithm from another person's program. This comparison can be done by sampling perhaps ten values of each applicable variable such as temperature and gross weight. If each person has used a different method to create his/her algorithm, then a good check can be made. The computer can do this sort of a run off using what is called a "FOR-NEXT" loop. It starts at perhaps 120,000 lbs gross weight and steps 5,000 lbs (your choice) until you've covered the entire gross weight range. The same can be

**Continued on Page 20**

## CFIC CORNER

# INS/DNS Does it really work or is it magic? (part 2)

**Maj Edward "Kirk" Whisman and**
**Capt Robert E. Mustard**
**Central Flight Instructor Course**
**Castle AFB**

This is the second of a two part discussion on the application of the INS/DNS as it pertains to the successful accomplishment of -135 aircrafts' global mission. As crew members, we constantly face the potential of having to react on a very short-term basis and fly missions anywhere in the world. As the importance of accurate navigation becomes increasingly essential to the accomplishment of these missions, the ability of the -135 crew member to maximize the use of the INS/DNS becomes mandatory. To fully utilize the capabilities of the INS/DNS we will closely examine what these systems can do during Orbit Functions, Grid Procedures and Air Alignment.

An important aspect of the INS/DNS is its orbit functions. The INS/DNS provides a wealth of information to the user and can be used either coupled or uncoupled with the autopilot. With the autopilot coupled to the INS, it is important to know that the procedure for entering the OPS function is not the same for all INSs. There are two completely different programs that could be loaded in your aircraft's INS. The original program (003) requires the aircraft to be parallel to the inbound track from the ARIP to the ARCP prior to using the OPS function. The newer program (005) contains the Inbound Track (IBT) function which allows the aircraft to enter the orbit from any direction. The flight manual does, however, state that it is not advisable to enter the Inbound Track function from some locations relative to the ARCP. The figures in section 8 of the partial flight manual should be used to determine the areas that are unacceptable, acceptable and usable. With the IBT, if the initiation of the orbital pattern steering function is delayed until the aircraft is within a 5NM radius of the ARCP, the entry will always be suitable. Occasionally, you may not find the program identification number logged in the aircraft's AFTO 781. If not, you can still determine the program that is loaded in the aircraft you are flying by accomplishing the following checklist taken from T.O. 1C-135(K)A-2-11:

a. Turn on the INS
b. Press CDU WAY PT CHG KEY. THE WAY PT CHG and INSERT/ADVANCE key lights come on.
c. Type 9-9 into FROM-TO DISPLAY.
d. Press INSERT/ADVANCE KEY. WAY PT CHG/INSERT ADVANCE lights go out.
e. Place data selector to WAY PT.
f. Set waypoint TACAN thumbwheel to 0.
g. Press N key. INSERT/ADVANCE key light comes on. Load 2776 into left display.
h. Press INSERT/ADVANCE key. INSERT/ADVANCE key light goes out.
i. Place data selector to DIS/TIME.

If the left and right hand data displays indicate 1367 0003, then the old program is in the INS. If the displays show 1367 0005, then the newer program containing IBT is inserted. Once the OPS function is initiated there are some additional options that are available for you to use while orbiting.

With the INS coupled to the autopilot, the 55 function can be used to turn the aircraft 180°. After the turn is complete the aircraft will continue orbiting since the OPS function is still inserted. A rendezvous can be accomplished down to turn range and offset once the OPS function is initiated, if when heading toward the receiver you have the aircraft intercept the outbound track and fly past the backside turn point by going to MAN on the AUTO/MAN switch. The final turn at turn range and offset, however, cannot be made with the autopilot coupled. To exit the OPS function you must manually insert two new way points in the FROM/TO display. Before doing this, you may wish to use the OPS function as a source of navigation data with the autopilot uncoupled. You can also gain valuable data from the INS/DNS if you insert the IP and CP coordinates as way points and use the CP in the TO window. By going to MAN on the AUTO/MAN switch they way points will not change while you are holding in orbit. The optimum readout using this technique would be 00.0 on both cross track and track angle error while inbound to the ARCP. While you are outbound from the CP you should look for approximately 9NM left for the cross track and 180° of track angle error. This technique would, additionally, allow you to use the DIST/TIME position for an alternate rendezvous by using the distance from the CP of both your aircraft and the receiver. These orbiting functions of the INS/DNS systems demonstrate the versatility of these new navigation systems and how they can greatly aid you in performing various navigational tasks.

The INS/DNS can additionally be extremely useful while flying in high latitudes when grid procedures are required for accurate navigation. The grid entry procedures for the INS/DNS are considerably different from using the ASN-7. It becomes vitally important for DNS accuracy that an accurate heading reference be provided. To insure the DNC receives a valid heading input you must take a few precautions. You must initially insure that the proper convergence factor is loaded in the DNC. Since the covergence factor is stored from one flight to the next, you must check this prior to entering grid. The Grid Heading Display checklist should be accomplished first which directs the loading of the convergence. If your route of flight is such that two different convergence factors are used and a chart changeover is required you must completely exit grid with the J-4 and DNC prior to changing the convergence factor. If you attempt to do this at extremely high or low latitudes (above 70N or below 60S), it will be very difficult to get an accurate heading for the DNC since no variation tables are inserted past these latitudes. When making a chart change, you must make sure that the proper variation is inserted in the DNC when going from unslaved (grid) to slave (mag) operation. If you're flying in these extreme latitudes a manual variation can be inserted. In other areas the DNS will use only the programmed tabular variation values.

During normal grid entry and exit with the DNS, everyone should be familiar with the warning light that illuminates when initiating and terminating the checklist. When the warning light comes on, you do not want to automatically go to system status and clear the warning indication prior to having the J-4 properly positioned on the correct heading. You, also, want the aircraft's heading to remain unchanged during grid entry and exit while the warning light is illuminated, since the DNC will ignore all heading alters.

On those occasions when your mission requirements dictate an ASAP launch, the DNS provides an excellent capability of being able to provide an air alignment function for the inertial navigation system. The air alignment checklist is very straight forward but the partial flight manual provides some additional basic information that clarifies the checklist. The navigation status number (1st digit on right hand data display) will indicate the phase of the alignment. A "3" will be displayed during dead reckoning operation. After the aircraft has leveled off and pitch and roll will not exceed 5.5 degrees the mode selector will be set to NAV. Once this is done, no more updates should be performed until the INS is completely aligned. The INS would translate a position update into a velocity change which could degrade the alignment. In addition, the aircraft should not be turned during this initial phase of alignment. When the navigation status number changes from a "3" to a "2", after approximately five minutes, the aircraft's heading can be altered. The navigation status number will switch to a "1" after at least an additional 32 minutes, which will indicate that air alignment is complete and the NAV mode has been entered. After the NAV mode has been obtained all functions of the INS can be performed including updates.

Now that we have discussed a few of the operating procedures and techniques associated with the INS and DNS, it becomes extremely important for everyone to work with these excellent pieces of navigation equipment to learn their capabilities. The results you will obtain should provide high levels of confidence in your abilities to fly anywhere in the world in order to accomplish our world-wide mission. Continue putting these systems through all their possible functions and if you find any new techniques or information that you would like to discuss feel free to give us a call at CFIC AUTOVON ext. 8-347-2235.

## LOW LEVEL . . .,

Continued from Page 7

Each is about two and one half hours long. The corridor of each route varies from four to six nautical miles either side of centerline. Enroute, true airspeed varies from 320 to 350 knots. All radar navigation and bombing is accomplished using dead reckoning and terrain features.

Of the two routes, IR-984 is the more challenging since leg segments cross land areas where relief data is incomplete. Terrain elevation and the precise location of terrain features are unknown. The only means of navigation through these segments of the route is dead reckoning. This means starting a stopwatch at the beginning of the leg at a known return and trusting your dead reckoning for a turn 15 minutes later into the bomb run. Heading must be exact to the degree, and airspeed must be monitored continuously. During the bomb run, the navigator must call out timing initiation point plus times to the radar navigator so that he knows when to expect offsets to appear at planned ranges and bearing for proper identification. All bomb runs are scored using radar camera photography. After two hours of flying terrain avoidance or pilot visual contour, each route has a final leg over water with a simulated minelaying run.

Following the low-level route, the cell rejoins at a common point using a modified point parallel rendezvous, seven and a half hours into the mission. The route back to Andersen is much the same as the flight down, returning over Papua. The number two aircraft for the first half of the mission leads the return flight. Another contingency high bomb run is completed on Manam Island.

After the bomb run on Manam Island, each crew starts a celestial navigation leg for one and a half hours of overwater navigation back to the Guam ADIZ. The navigation leg usually utilizes integrated day celestial procedures. If the moon is available, it can be used for a two-body fix. The navigation leg contains two peculiarities due to the location over which it is flown. First, if it is flown over a grid, a compass swing of 90 degrees is required because the orientation of grid north changes when crossing the equator. Secondly, even though the navigation leg is entirely over water, pressure pattern is not carried since it lies between 20 degrees south latitude and 20 degrees north latitude.

Several minutes after the high level navigation leg is completed, the bombers penetrate the ADIZ and make contact with Guam air traffic control. The crews are usually cleared for an enroute descent to the initial approach fix for a tactical air navigation or precision approach radar landing.

The mission ends at 6 p.m., some eleven hours after take-off.

## MAGIC . . .,

Continued from Page 17

done for the temperature, pressure altitude, and so forth. The computer can keep track of the maximum differences between the algorithms and tell you where they occur. This approach using the computer is particularly useful for the critical engine failure/refusal speed calculation. Here, with nine variables to enter the charts and supposing you wanted to sample ten of each variable (e.g. ten temperatures), you would have $10^9$ permutations or a thousand-million "sets" of takeoff data. Now you know why it's so hard for anyone to cook up a practical set of universal tab data. Maybe they could issue our copilots a wheelbarrow to carry it all!

I hope the above discussion will set a few minds at rest concerning the issue of verifying the accuracy of computer generated takeoff data. But here are two final thoughts in case you still have some misgivings. Who checks the takeoff data now? How is it checked?

Let's return now to the two unanswered questions of the original three (people forgetting how to do takeoff data and integrating this computer capability into daily operations). The first question is answered partially by the second. Individuals who use the computer exclusively may lose some ability to handwork takeoff data, but this can be avoided by setting up proper administrative procedures for the use of the computer. (This difficulty also exists with tab data, incidentally.)

My earlier proposal of handworking a set of takeoff data on mission planning day and checking it with the computer could be one procedure for keeping pilots proficient at figuring takeoff data from the performance manual. While we're talking about people who might abuse the computer and any hassles involved in setting up administrative procedures, we should review some of the many benefits the computer offers. The computer will markedly improve the accuracy of takeoff data used in daily operations, adding a significant degree of safety. It will reduce the crew irritant aspects of handworked takeoff data. It offers an attractive alternative to cumbersome tab data. It can provide additional flexibility in the operational environment because commanders will have quick and accurate performance information for existing conditions. These are significant benefits!

Everything I've said about the theory behind the takeoff data, the capabilities, and the questions I've raised I hope will clear up any misconceptions you might have and give you food for thought.

The performance manual charts are actually a good way to compact a lot of data into a few pages. We've used this technique successfully for years, but the computer, as you can see, offers a way to improve on this to the great benefit of our operations.

**Continued from Page 15**

The last 60:1 application involves planning the descent to MDA or DH. For a non-precision approach use the same technique as descending from altitude except use groundspeed NM/min instead of MACH to determine VVI. Thus you have an exact pitch reference (alt - dist), VVI reference (NM/min X pitch); and altitude loss vs DME crosscheck to insure you arrive at the MDA with enough time and distance remaining to accomplish a safe landing. An easy and terribly accurate technique for establishing and maintaining glide path during precision approaches involves groundspeed. A 3° glide slope approach requires an approximate VVI ½ the groundspeed plus a zero, whereas a 2.5° glideslope requires ½ the groundspeed plus a zero minus 100′. For example, a 3° glide slope at 150 NM/min groundspeed = 750′/min VVI

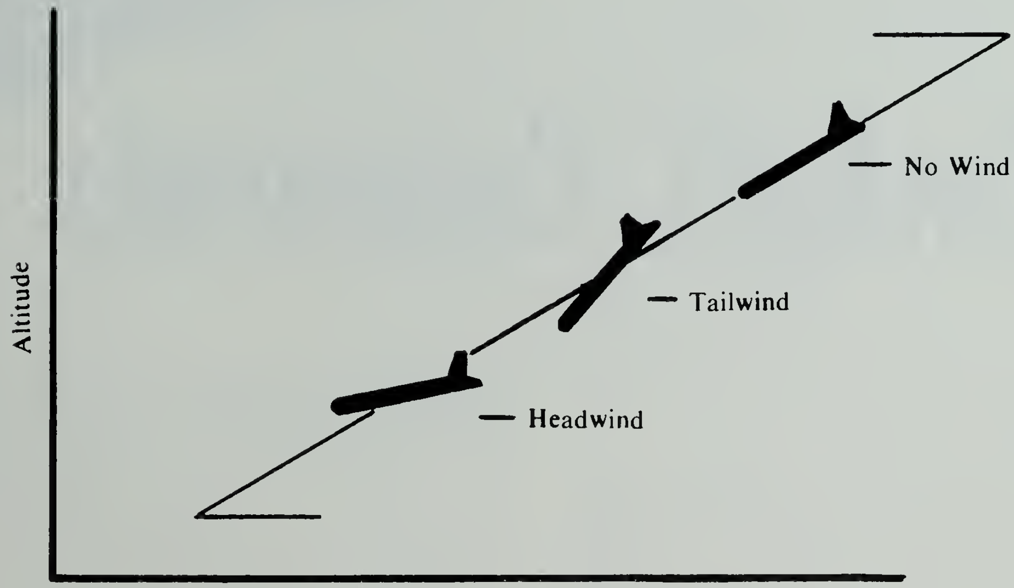
$$\left( \frac{150}{2} + \text{a zero} = 750'/\text{min} \right);$$

2.5° glide slope at 150 NM/min = 650′/min VVI =

$$\left( \frac{150}{2} = \text{a zero} - 100' = 650'/\text{min} \right).$$

Comparing these values with those published in an approach book reveals 795′/min for a 3° descent and 665′/min for a 2.5° descent. This technique is especially useful when wind shears or strong headwinds/tailwinds exist on final. With groundspeed rapidly changing, an easy mathematical computation enables you to immediately know what VVI is required to precisely maintain the glidepath.

Every technique presented here and many more are contained in AFM 51-37. If you haven't dusted it off lately, it would definitely behoove you to study it. Some techniques (such as using zeros instead of multiplying by 10 or 100) are only offered to help reduce the mathematics. As you can see, the mathematics involved in descending from altitude to approach minimums and intercepting courses enroute are quite simple. In fact, these equations/relationships become second nature with practice. Grab a simulator and practice these 60:1 instrument techniques. If you have never used these techniques, you will definitely be surprised as to how precisely you can position yourself. Then start applying them in your aircraft. 60:1 allows a pilot to put any aircraft where he wants it, when he wants it, no matter what the situation. Precise instrument flying becomes a consistent reality.



DESCENT GRADIENT = 3° = 300′/NM
NO WIND: PITCH CHANGE = 3° TO MAINTAIN 300′/NM
TAILWIND: PITCH CHANGE 3° TO MAINTAIN 300′/NM
HEADWIND: PITCH CHANGE 3° TO MAINTAIN 300′/NM

FIG. 2

Captain James M. Sullivan
Chief, Instrument Division
1st Combat Evaluation Group
Barksdale AFB, Louisiana

# Cockpit Comments

"I have the strobes."

"Roger."

"Runway. Go visual."

"Roger — got it."

The terminology may vary at times, but the scenario is a familiar one — interphone coordination during the final stages of an instrument approach. During the past few years, SAC has investigated various methods of crew coordination and our flight manuals reflect the minimum requirements. the procedures we now use are good ones. However, as we modernize our equipment and continually review our procedures, we should be on the lookout for better and safer ways to do things.

The SAC senior staff convened a special review board to do just that and one of the board recommendations was a review of all MAJCOM and airline cockpit instrument approach procedures to see whether someone else has a better mousetrap. Research in this area revealed some interesting and, perhaps, valuable techniques which you might find useful. Remember — these are **techniques** and should not be considered as substitutes for sound procedure. AFM 51-37 refers to these techniques in a general manner. We thought you might be interested in some specific suggestions used by other aviators. The first of these concerns ILS final approach. The pilot or crew member not flying the aircraft reports course deviations greater than ½ dot and glide slope deviations greater than 1 dot, unless a

# BIG INSTRUMENT

proper correction is being initiated. On any approach, from the FAF or glide slope interception inbound to the DH/MAP, the pilot not flying will notify the pilot flying the aircraft if vertical velocity differs by more than 200 feet from the planned descent rate: "Sink — 1100,"

As you approach the runway on any instrument approach, the following suggestions might be useful. The pilot not flying the aircraft announces that he has some portion of the runway environment in sight and the clock position. "Cue — 12 o'clock." This will alert the pilot flying to begin to bring outside references into his crosscheck. As the approach continues, the crew member not flying will announce when, in his opinion, he can see enough of the runway environment to insure a safe landing: "Runway." The pilot flying then evaluates the visual references and formulates a decision to land or execute a missed approach.

For the sake of comparison, you might be interested in the interphone procedures used by our Starlifter brothers in MAC. The following mandatory calls are made by the pilot not flying the aircraft:

a. Nonprecision approaches:
   (1) One hundred feet above minimum altitudes.
   (2) "Minimums" at MDA.
   (3) "Runway in sight." Do not call too soon when obstructions to vision, such as fog, haze, low stratus clouds, etc., are present.
   (4) "Go-around." Call at missed approach point if the runway environment is not in sight.

b. Precision approaches:
   (1) One hundred feet above decision height (DH).
   (2) "Land." Make this at decision height if the runway environment is in sight and the aircraft is in a position for a normal landing.
   (3) "Go-around." Make this at decision height if the runway environment is not in sight or if the aircraft is not in a position for a normal landing.

SAC B-52 OAS modifications present another possible avenue for crew coordination during instrument approaches. The new radar altimeter is much more precise and accurate than the old one and radar altimeter information is displayed digitally on the radar scope. After DH/MDA, it might be helpful for the radar navigator/navigator to announce 100 feet and 50 feet radar altitude. Remember that 50 feet approximates normal threshold crossing height. This reminder of actual aircraft height might be valuable in alerting pilots of developing duck-under situations when both pilots are deceived by a visual illusion. You should remember one other technique in "The Good Book." AFM 51-37 suggests that highly qualified copilots fly the approach. This technique allows the pilot to integrate visual cues into his crosscheck and decide whether to land the aircraft or direct the copilot to execute a missed approach.

These thoughts on approach coordination and communication are really, as we said, suggestions. You and your crew should consider them as additions to your bag of tricks. Whether you are comfortable with them is a personal matter. In any case, use what works for you to keep 'em flying.

AN AFTERNOON IN THE LIFE
**Continued from Page 9**

Enter the table with the ground speed and the correct ballistics altitude, found on the Radar's bomb forms. Follow the ground speed down and the ballistics altitude across until they intersect. The number at this intersection is the desired TTR. This TTR is good only when flying at that ballistics altitude. To adjust for actual aircraft altitude (AGL), add one second for each 100 feet of altitude above the ballistics altitude (Subtract if lower). Note the importance of altitude! This one second equates to approximately 600 feet. Using this table can refine your bomb score, making the visual release an accurate and reliable method of weapon delivery.

An example is in order. Let's say the ballistics altitude is 650 feet, the ground speed on this run is 320 knots, and the aircraft is flying at 1000 feet AGL. From the table the TTR turns out to be one second, but because the aircraft is 400 feet above this altitude, we must add four seconds. The table is based on 100 foot increments so, we round the ballistics altitude to the lower 100 feet. In our case we use a 600 foot ballistics altitude. Adding this correction, we will wait five seconds after the visual passes under the nose before we cut the tone.

Seat position is important. Since no sophisticated sighting tools are available, we need a simple way to guarantee consistent cockpit references when making a visual bomb run in the B-52D. With the seat full forward and level tilt, set the seat so eye level is exactly one slipstick length below the bottom of the cockpit dome light (One clip board length will do). Once the setting is made, and cockpit references are noted for future use, the seat should be readjusted to the position used for normal flight.

It is clear that the afternoon in the life of this crew would have gone a lot better at Missmark bomb plot had they employed good integrated bombing techniques. Knowledge of the visuals, timing procedures, and targets is essential as well as use of the heading set marker and the time to release table. All aircrews have a commitment to ensure maximum bombs on target and it is the responsibility of every pilot team to back up the nav teams on bomb runs with good integrated bombing techniques. The **next** time, Missmark could be the ORI and good news, like bombs on target, is always nice to bring home.

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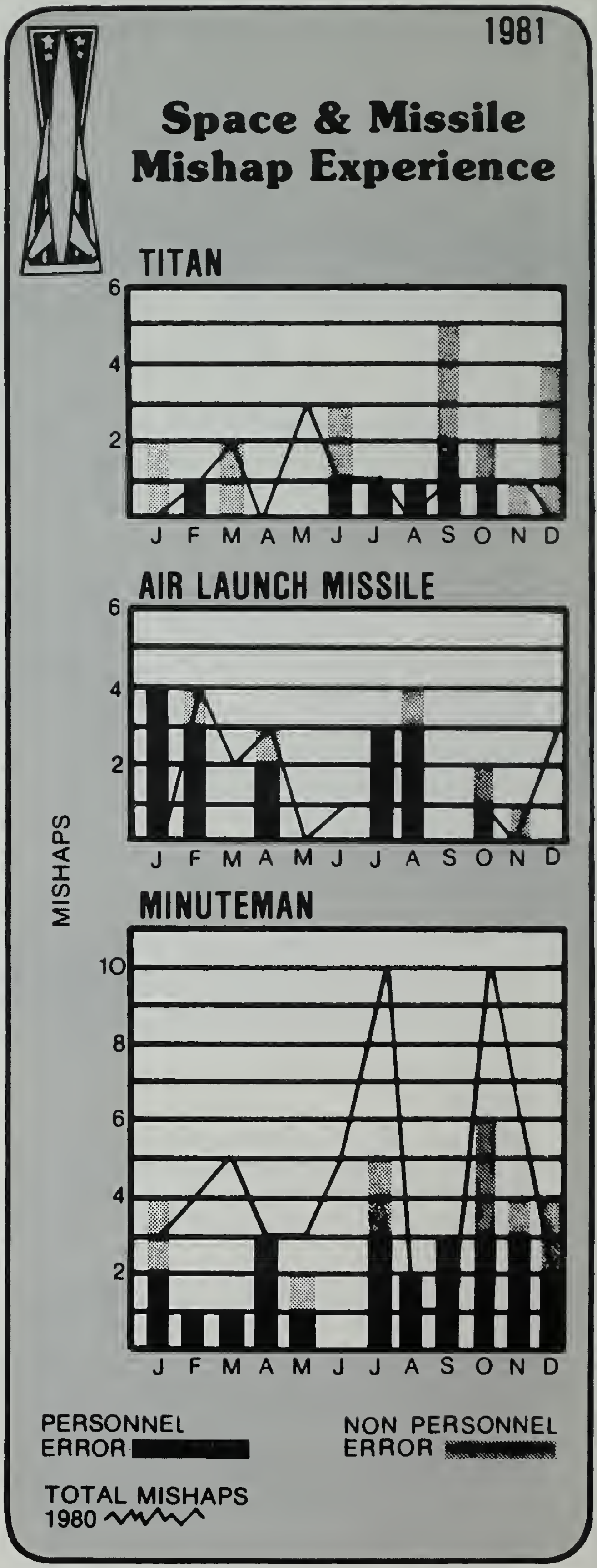
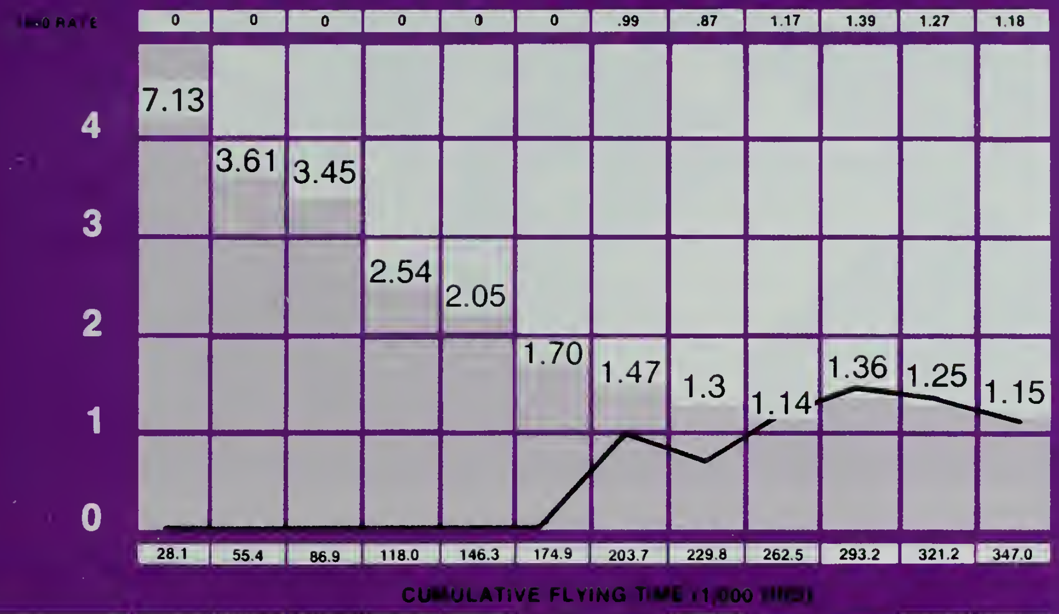
*The altitude, called into the bomb plot prior to the run, from which the site assumes a weapons release will be made; regardless of actual aircraft altitude at release.



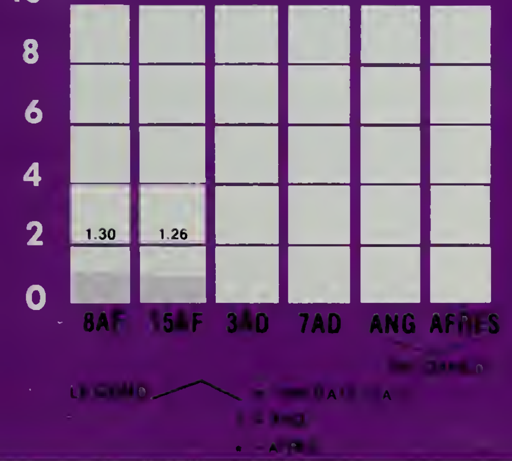
# 1981 Flying Safety Rate

## SAC CLASS A MISHAP RATE (PER 100,000 FLYING HRS)



| MISHAPS | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 1 | 0 | 0 |
| 1981 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

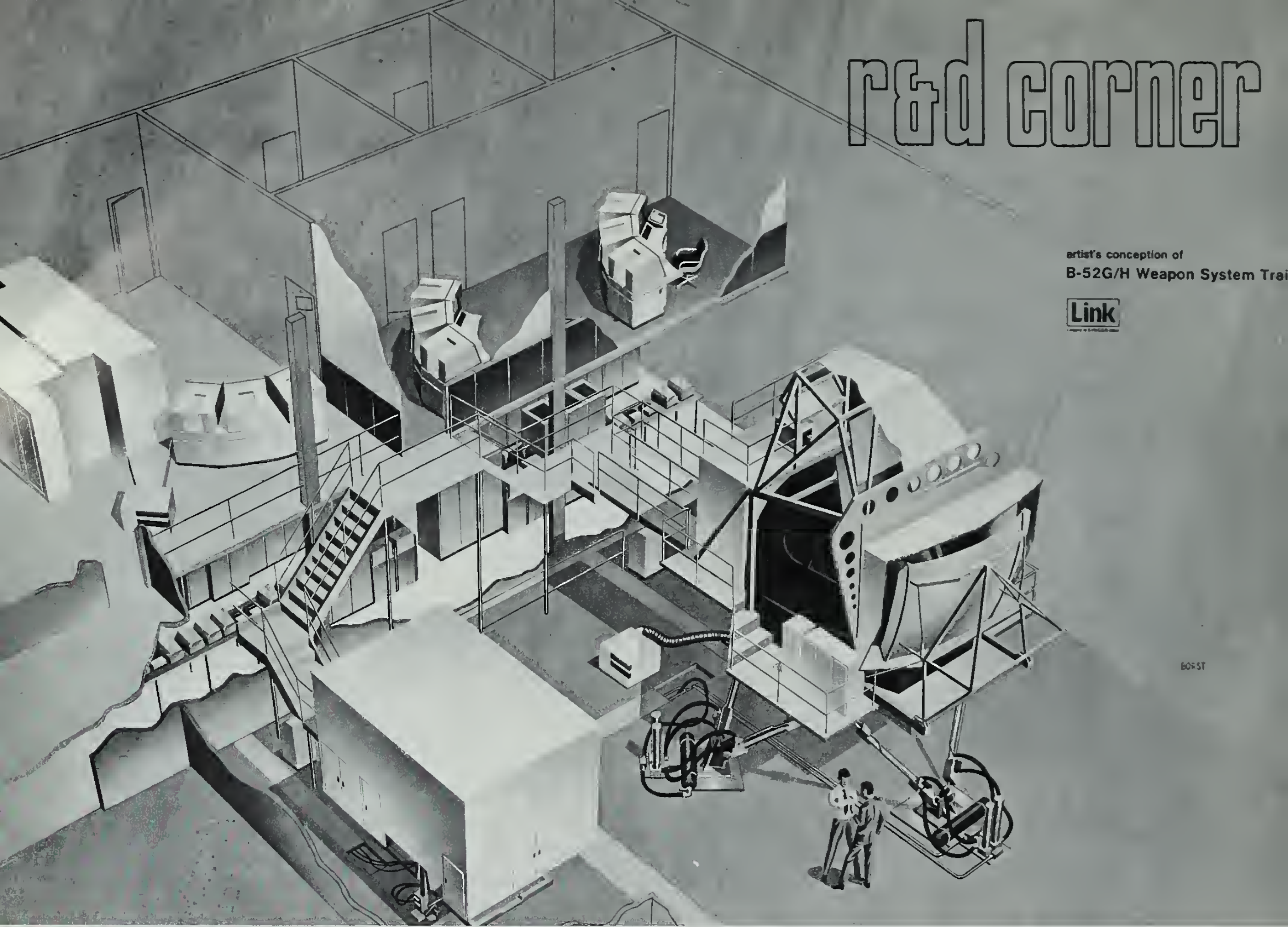
## 1981 SUBORDINATE CMD RATES



## MISHAP STATUS

| | |
|---|---|
| KC-135 A | JAN '81 |
| FB-111A | JAN '81 |
| RC-135S | MAR '81 |
| B-52D | OCT '81 |

r&d corner



artist's conception of
B-52G/H Weapon System Trai

Link

# THE B-52 G/H WEAPON SYSTEM TRAINER

**Major John E. Magness**
**HQ SAC, XPHD**

While the B-52 is one of the oldest weapon systems in the SAC inventory, it continues to be the backbone of our strategic deterrence. As the "BUFF" will remain in the inventory for many years to come, we must accommodate the operational mission with a training concept that maximizes aircrew proficiency while minimizing training cost and airframe fatigue. This philosophy is expressed in the B-52 Instructional System Operational Concept (ISOC). The concept integrates flying, simulator, and academic training into a total system curriculum which is used in support of initial qualification and continuation mission training. The remainder of this article will deal specifically with the B-52 Weapon System Trainer (WST) which is the aircrew training device component of the B-52 ISOC. The B-52 WST is a sophisticated, high-fidelity aircrew training device which will provide mission/EWO rehearsal capability with the aircrew activity/interactivity as it would be on an actual EWO mission.

## ACQUISITION HISTORY

SAC identified the need for new ground based training devices in 1974. Shortly thereafter, the Air Force validated the requirement and directed procurement of the equipment. The Air Force procured the needed WST on a competitive flyoff basis. Two contractors were selected and paid to build prototype B-52 WSTs. Testing on the prototypes began in 1979 and was completed in 1980. In May of 1980, the Air Force selected Singer Company-Link Division's WST as the winner and awarded Singer-Link the production contract.

Singer-Link disassembled the pilot production unit (PPU) at their facility and permanently installed it at Castle AFB, California. The Air Force formally accepted the WST in September 1981.

## SYSTEM DESCRIPTION

The B-52 WST is composed of three separate aircrew stations; (1) Flight, (2) Offensive, and (3) Defensive, all with onboard and offboard instructor stations. The three crew stations can operate in an independent mode, a mixed mode (flight and offensive together and defensive station independent) or fully integrated for total mission rehearsal.

## THE FLIGHT STATION

The flight station is equipped with a full motion system that will provide aerodynamic cues in all phases of flight, including takeoff, climbout, aerial refueling, low level and landing. It will also provide cues necessary for engine out conditions and aerodynamic differences caused by varying weapons loads, system failures, and battle damage.

The flight station is also equipped with a day/night computer generated visual display capable of air refueling, transition, and low level Electro-Optical Visual System (EVS) training. EVS displays are computer generated imagery extracted from a large digitized landmass system. In addition, aerial refueling simulation with a KC-10 will be added on the production program. Each B-52 base will be modeled for transition training.

The flight station will also be a full instrument trainer. Complete instrument simulation is provided with representative navigational aids available to practice approaches, departures, point-to-point navigation, and position location anywhere on the digitized landmass.

Finally, the flight station is a full systems trainer. All systems functions/failures can be simulated and the pilots have the capability to interact with systems to effect alternate means of system operation and to correct malfunctions.

## THE OFFENSIVE STATION

The offensive station is on a limited motion base and is also a complete systems trainer. The unit will include the Phase I Offensive Avionics System (OAS). The PPU will be retrofitted to incorporate the OAS. The offensive station will also include complete radar and EVS simulation.

## THE DEFENSIVE STATION

The defensive station is on a static base. It includes complete system simulation of the defensive avionics and gunnery systems. In the integrated mode, as the pilot turns or makes the flight station climb or descend, threats will move on respective scopes; hence the defensive team can practice maneuvers in real time and see the resulting effects. The defensive team will be able to practice all evasive actions including terrain masking. Additionally, threats can be generated in a mission which will change frequencies and search patterns as it tries to lock on to its target. Ineffective countermeasures by the defensive team result in simulated combat damage. The system has the capability to progressively inflict battle damage if so desired.

## THE INSTRUCTOR STATION

Each crew station has offboard and onboard instructor positions. The offboard station controls the entire training scenario. It has the capability for real time inputs including malfunction insertion and deletion. In the integrated mode, the flight station instructor controls the mission scenario although each instructor station still retains control over station unique training, for example inserting malfunctions that affect only the respective aircrew station. The onboard station has limited scenario control. The scenario is controlled by a Special Effects Control Unit, which is a handheld device. This allows the onboard instructor to do such things as freeze the training scenario and reposition the simulated location of the device.

## EMPLOYMENT CONCEPT

The employment concept calls for 17 WSTs, three deployed at Castle AFB in support of CCTS and CFIC and one for each B-52G and H squadron. To date, ten have been procured; two for Castle AFB and one each for Griffiss, Wurtsmith, Grand Forks, Fairchild, K. I. Sawyer, Minot, Carswell and Ellsworth AFBs. The Griffiss WST will be the first equipped with OAS simulation capability, while the PPU and the first production unit will be retrofitted with OAS at a later date. The additional WSTs will be procured for the remaining "G" bases when funds are available.

## INCORPORATION INTO TRAINING CURRICULUM

The B-52 WST will be the single training device at all main operating bases. As the WST is declared ready for crew training, the respective trainers currently at the base will be retired. At the CCTS base, however, three cockpit procedures trainers and four electronic warfare trainers will be retained for lead-in training to the WST.

## CONCLUSION

As you can see, the command has embarked on an ambitious course to supply its crews with a state-of-the-art training device. The B-52 WST will be able to train an entire crew in all phases of the mission. Through prudent application of this portion of the training curriculum, the command will have more effective and proficient aircrews.

Missile Crew of the Month

MINUTEMAN Crew R-133, 351st SMW, Whiteman AFB MCCC 1Lt Greg Smith, and DMCCC 2Lt Bob Sullivan, is SAC Crew of the Month. They earned perfect ratings of 5.0 highly qualified ratings in their upgrade evaluation. After upgrade, the crew was on alert at Foxtrot LCC. While processing checklists for an input line lost for LF F-07, the same sortie dropped LF/NO-GO. This serious maintenance problem was further complicated by serious security situation at the same facility. The "Helping Hand" and maintenance situation demanded accurate monitoring and relaying of status to wing security control and wing job control to defuse a very serious event. On the next alert, while monitoring numerous maintenance teams' activities, the crew heard a report that some team members had come in contact with a "clear syrup-like liquid." They immediately reacted to the possibility of dangerous PCB substances being involved. They halted maintenance until the situation was investigated by environmental health personnel thus preventing a potentially hazardous event from developing further. On the following alert, the crew was required to close the LCC blast valves to support maintenance. Once the blast valves were closed, emergency procedures were required to supply cooling air to sensitive equipment racks. When it was time to open the blast valves, the crew determined that a malfunction existed preventing normal opening of the blast valves. After coordinating with wing job control the crew used emergency procedures to open the blast valves. While the blast valves were malfunctioning, the crew took all actions necessary to minimize potential degradation of the LCC.

Missile Maintenance Airman of the Month

Technical Sergeant Stephen M Molchan, 341 SMW, Malmstrom AFB, Montana, has been selected as the SAC ICBM Maintenance Airman of The Month. TSgt Molchan has maintained a record of excellence beginning with his assignment as a Mechanical Shop Evaluator. During this tenure he was selected as a competitor at the SAC Missile Combat Competition, Olympic Arena, where his team was selected as the "Best Minuteman Mechanical Shop Team" for that year. Later, he was selected as the NCOIC of the Mechanical Shop where he identified a potentially hazardous problem with a nuclear certified hoist and implemented a fleet-wide solution. More recently, he was responsible for insuring that all equipment was functional in support of the 1981 Simulated Electric Launch Test. His pre-test preparations and close equipment monitoring insured that all equipment requirements were fulfilled as scheduled. TSgt Molchan's performance of all duties has been outstanding and identifies him as a valuable asset to the SAC ICBM Maintenance effort and the United States Air Force.

# PROFESSIONAL PERFORMERS

## Flight Maintenance Airman of the Month

Senior Airman Scott J. Palmer, 96th Organizational Maintenance Squadron, Dyess Air Force Base, Texas has been selected as the Strategic Air Command Maintenance Airman of the Month. Senior Airman Palmer is assigned to the 96th Organizational Maintenance Squadron Bomber Branch as the Crew Chief on B-52 56-670. In June 1981, Senior Airman Palmer was selected to represent the 96th Bombardment Wing in the highly competitive Strategic Air Command's GIANT SWORD Weapons Loading Competition. During the grueling ten days of competition Senior Airman Palmer competed against nineteen of the best crew chiefs in the entire Strategic Air Command. He emerged triumphant and won the honor of Best Aircraft Crew Chief in the Fifteenth Air Force and placed second in the entire Command. Senior Airman Palmer's task evaluations during the munitions loading operations were also error-free. He placed second in the aircraft pre-load competition amassing an enviable score of 95. His outstanding initiative and proficiency are clearly evident in the daily performance of his duties as crew chief of a B-52. His aircraft has maintained a consistent on-time takeoff record for missions and the lowest delayed discrepancy rate of any aircraft assigned to the 96th Bombardment Wing. During readiness exercises, Senior Airman Palmer always completes the generation of his aircraft in minimal time and has it ready for launch ahead of schedule. He accomplishes these facts in the most professional manner, as evidenced by the ratings he has received from Quality Control on follow-up inspections and task evaluations. Senior Airman Palmer has become an extremely valuable asset to the 96th Organizational Maintenance Squadron, the 96th Bombardment Wing, and the Strategic Air Command.

## Flying Crew of the Month

Capt John Blewitt, IP, and Capt Mike Hoekman, CP, 380th BMW, were on an FB-111A pilot-proficiency training sortie when a loud bang was heard and felt emanating from the main wheel well area. The crew received an unsafe gear indication and lost the utility hydraulic system. An emergency was declared and a straight-in radar approach was planned. A moment later smoke and fumes entered the cockpit causing the aircrew to suspect a possible wheel well fire. Capt Blewitt immediately pulled the aircraft into a closed visual pattern while Capt Hoekman ran vital checklists. These checklists required the emergency extension of the flaps and slats and extension of the landing gear using the backup pneumatic system. The aircrew requested and received a visual inspection of their landing gear by another FB-111 in the visual pattern. This inspection confirmed their down and locked indications in the cockpit. The aircrew accomplished a flawless hydraulic system failure landing. Investigation revealed that the main landing gear actuator had torn itself from the bulkhead and ripped the downlock actuator from its upper attachment. This meant that the main landing gear was not held in the down and locked position. The superior airmanship of Capt Blewitt and Capt Hoekman and the aircrew's outstanding coordination and knowledge of aircraft systems prevented a failure of the main landing gear during landing.

The following poem was written by Margaret Miller while serving as an intelligence officer at Whiteman AFB. It is her salute to SAC's missile and aircraft crewmembers.

# CREDO

*A laughing plane from distant far*
*sang cadence to the highs*
*and brass crashed brass*
*next to the flash*
*of eyes raised to the sky.*
*A fainting star, this earth-born eagle*
*whistled through the clouds*
*of a plum and rose*
*no artist knows,*
*steep and clean and proud.*
*And in an earth*
*of dark and calm,*
*a quieter brass band played,*
*that sang of men*
*who watch and wait*
*while lights of cities fade.*
*And sang of men*
*whose steady hand*
*tempers topside glory;*
*while children romp*
*and old men nod,*
*beats yet this other story.*
*"Oh God, our Father," he intoned,*
*"bless this land we love."*
*And Air Force still,*
*stands silent watch,*
*earth-bound and above.*

*M. Miller*

# SAC SAFETY SCREEN

**22 BMW, March Crew E-30:** P Capt Robert A Damico, CP 1Lt Gaetano Degioia, RN Capt David C Loewer, N 1Lt Raymond J Glynn, EW Capt Frank E Lourenco, G SSgt Mark E Rasmussen

**22 BMW, March Crew S-120:** P Maj James E Otterbein, CP Capt Ramon P Mata, N Capt Thomas J Solecki, BO SSgt Carl S Seaberry

**9 BMS, Carswell Crew S-02:** P Capt Francis X Cantwell, CP Capt Edward N McKinney, RN Capt Hubert D Murdock, N 1Lt Joseph C Howard, EW Capt Harold O Arboqust Jr, G SSgt Mark A Lough

**7 AREFS, Carswell Crew R-135:** P Capt Carmen D Villani, CP Capt Joseph Brown, N Capt Richard A Sanchez, BO SSgt Maurice Elliott

**4018 CCTS, Carswell IT-6:** IP Capt Karl M Peters, IRN Capt Troy Jordan, IEW Capt Charles L Hanna, IG TSgt William O Miles

**9 BMS, Carswell Crew E-72:** P Capt Mark W Baker, CP Capt John F Kerl, RN Capt Julian T Manship, N Capt Danny S Wilmoth, EW Capt John S Sakai, DAG SSgt John P Denzer

**9 BMS, Carswell Crew E-81:** P Capt Lawrence A Loeffler, CP 1Lt Kevin J Kirsch, RN Maj Maurice L Shelton, N 1Lt Michael J Gunning, EW Capt Thomas R Morrill, DAG SSgt Randall L Sanderson

**20 BMS, Carswell Crew E-32:** P Capt Bernard M Mudd, CP Capt Michael D Rudisill, RN Capt Ronald A Westman, N 2Lt Juan M Gonzales, EW Capt Mark W Cornwell, G A1C Gary G Freeman

**62 BMS, Barksdale Crew E-22:** P Capt Milton H Waddell, CP Capt Leonard R Chrishon, RN Capt Charles M Vanderberg, N 1Lt Bruce A Hanson, EW Capt Peter W Bollinger, AG SrA John V Perry II

**596 BMS, Barksdale Crew R-63:** P Capt William R Tooker, CP Capt Thomas M Sapp, RN Capt Jerry M Huff, N 1Lt Harley D White, EW Capt Joseph D Timm, AF A1C Lewis J Long

**913 AREFS, Barksdale Crew E-108:** P Maj Arthur R Zeitler, CP 1Lt Timothy W Hurst, 2Lt Stephen W McCool, BO SSgt John B Stanford

**55 SRW, Offutt Crew E-19:** FP Capt Chris P Hoffman, CP Capt Mark E Pestana, NN Capt Frank H Rasmussen, NN Capt Lawrence C Kling Jr

**170 AREFG, McGuire AFB:** P Maj Hugh H Wilson Jr, CP Capt John C Fiore, N Maj Michael R Powell, BO SMSgt George R Fusco

**909 AREFS, Kadena Crew E-141:** P Capt Marc D Felman, CP 1Lt Billy Ridgway, NN Capt Douglas J Waples, IS TSgt Paul A Lowe

**381 SMW, McConnell Crew R-043:** MCCC 1Lt Gregory C Assad, DMCCC Capt Winston E Guthrie, MSAT Sgt Charles J Bibeau, MFT SSgt William E Speed

**308 SMW, Little Rock Crew R-129:** MCCC 1Lt David W Wright, DMCCC 2Lt Randall D McRae, MSAT SrA Mark S Cunningham, MFT Sgt Mark A Brasseur

**91 SMW, Minot Crew E-024:** MCCC 1Lt Martin D Potash, DMCCC 2Lt Robert S Reafler

**90 SMW, F E Warren Crew R-173:** MCCC 1Lt Frederick M Vornbrock, DMCCC 2Lt Steven C Hull

**321 SMW, Grand Forks Crew E-070:** MCCC Maj Henry F Iwanowicz, DMCCC 2Lt Arnold Schumacher

**The SAC Safety Screen is an honor roll of SAC's most professional crews. To gain listing on the Screen, crew members must be nominated by their unit commanders and meet high selection criteria of experience in their aircraft or missile system *IAW SACR 127-2*.**

UNIVERSITY OF FLORIDA
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FLARE

# HALL OF FAME

FLARE

## TACTICAL FLYING

### OVER TWENTY-FIVE YEARS

| | |
|---|---|
| 170 AREFG, McGuire (NJANG) | Feb '56 |

### OVER TWENTY-THREE YEARS

| | |
|---|---|
| 171 AREFW, Greater Pittsburgh (PAANG) | Mar '58 |
| 157 AREFG, Pease (NHANG) | June '58 |

### OVER TWENTY-TWO YEARS

| | |
|---|---|
| 940 AREFG, Mather (USAFR) | May '59 |
| 307 AREFG, Travis | Sep '59 |

### OVER TWENTY YEARS

| | |
|---|---|
| 151 AREFG, Salt Lake City (UTANG) | Feb '61 |
| 161 AREFG, Sky Harbor (AZANG) | Apr '61 |
| 126 AREFW, Chicago O'Hare (ILANG) | Apr '61 |
| 134 AREFG, McGhee Tyson (TNANG) | Aug '61 |

### OVER NINETEEN YEARS

| | |
|---|---|
| 11 SG, Fairford | Feb '62 |
| 340 AREFG, Altus | Jun '62 |
| 96 BMW, Dyess | Aug '62 |

### OVER EIGHTEEN YEARS

| | |
|---|---|
| 19 BMW, Robins | Aug. '63 |

### OVER SEVENTEEN YEARS

| | |
|---|---|
| 160 AREFG, Rickenbacker (OHANG) | Dec '64 |

### OVER SIXTEEN YEARS

| | |
|---|---|
| 320 BMW, Mather | Jul '65 |

### OVER FIFTEEN YEARS

| | |
|---|---|
| 452 AREFW, March (USAFR) | Sep '66 |

### OVER FOURTEEN YEARS

| | |
|---|---|
| 92 BMW, Fairchild | Feb '67 |
| 55 SRW, Offutt | Jul '67 |
| 2 BMW, Barksdale | Aug '67 |

### OVER TWELVE YEARS

| | |
|---|---|
| 5 BMW, Minot | Feb '69 |
| 42 BMW, Loring | Sep '69 |
| 141 AREFW, Fairchild (WAANG) | Oct '69 |

### OVER ELEVEN YEARS

| | |
|---|---|
| 28 BMW, Ellsworth | May '70 |

### OVER NINE YEARS

| | |
|---|---|
| 101 AREFW, Bangor (MEANG) | Mar '72 |
| 306 SW, Mildenhall | Apr '72 |
| 416 BMW, Griffiss | May '72 |
| 305 AREFW, Grissom | Aug '72 |

### OVER EIGHT YEARS

| | |
|---|---|
| 379 BMW, Wurtsmith | Apr '73 |

### OVER SEVEN YEARS

| | |
|---|---|
| 931 AREFG, Grissom (USAFR) | Feb '74 |
| 384 AREFW, McConnell | Mar '74 |
| 189 AREFG, Little Rock (ARANG) | May '74 |
| 43 SW, Andersen | Dec '74 |

### OVER SIX YEARS

| | |
|---|---|
| 68 BMW, Seymour Johnson | Sep '75 |

### OVER FOUR YEARS

| | |
|---|---|
| 410 BMW, K.I. Sawyer | Apr '77 |
| 190 AREFG Forbes (KSANG) | Apr '77 |
| 128 AREFG Milwaukee (WIANG) | Jul '77 |

## ICBM

### OVER SEVENTEEN YEARS

| | |
|---|---|
| 1 STRAD, Vandenberg | Sep '64 |

### OVER ELEVEN YEARS

| | |
|---|---|
| 341 SMW, Malmstrom | Apr '70 |

### OVER EIGHT YEARS

| | |
|---|---|
| 390 SMW, Davis-Monthan | Jul '73 |

### OVER SEVEN YEARS

| | |
|---|---|
| 351 SMW, Whiteman | Oct '74 |
| 91 SMW, Minot | Nov '74 |

### OVER FIVE YEARS

| | |
|---|---|
| 321 SMW, Grand Forks | Feb. '76 |

To gain listing in the Hall of Fame, a SAC or ARF unit must be Class A mishap-free for 48 months.

*U.S. Government Printing Office
1981 — 765-047/11